US009521471B2

(12) **United States Patent**
Araki

(10) **Patent No.: US 9,521,471 B2**
(45) **Date of Patent: Dec. 13, 2016**

(54) **LINE ACCOMMODATING APPARATUS AND TEMPERATURE CONTROL METHOD**

(75) Inventor: **Hiroshi Araki**, Tokyo (JP)

(73) Assignee: **NEC CORPORATION**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 962 days.

(21) Appl. No.: **13/387,360**

(22) PCT Filed: **May 24, 2010**

(86) PCT No.: **PCT/JP2010/058702**
§ 371 (c)(1),
(2), (4) Date: **Jan. 26, 2012**

(87) PCT Pub. No.: **WO2011/013436**
PCT Pub. Date: **Feb. 3, 2011**

(65) **Prior Publication Data**

US 2012/0119589 A1 May 17, 2012

(30) **Foreign Application Priority Data**

Jul. 31, 2009 (JP) 2009-179341

(51) **Int. Cl.**
H01H 35/00 (2006.01)
H04Q 1/28 (2006.01)

(52) **U.S. Cl.**
CPC ***H04Q 1/28*** (2013.01); *Y10T 307/773* (2015.04)

(58) **Field of Classification Search**
CPC H01H 35/00; H01H 37/00; H01H 47/00
USPC 307/117
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,205,010 B1 * 3/2001 Ohsaka H03K 17/0822 307/117
2003/0126473 A1 7/2003 Maciorowski et al.
2008/0116852 A1 * 5/2008 Kuo H01M 10/052 320/136

FOREIGN PATENT DOCUMENTS

JP 60-041854 A 3/1985
JP 60041854 A * 3/1985
JP H3-178249 A 8/1991
JP H07-154836 A 6/1995
JP 2002-236058 A 8/2002
JP 2002-305610 A 10/2002
JP 2003-150280 A 5/2003
JP 2005-311195 A 11/2005
JP 2006-246616 A 9/2006
JP 2007-199782 A 8/2007

(Continued)

OTHER PUBLICATIONS

Taiwanese Office Action dated Jun. 4, 2013 with English translation thereof.

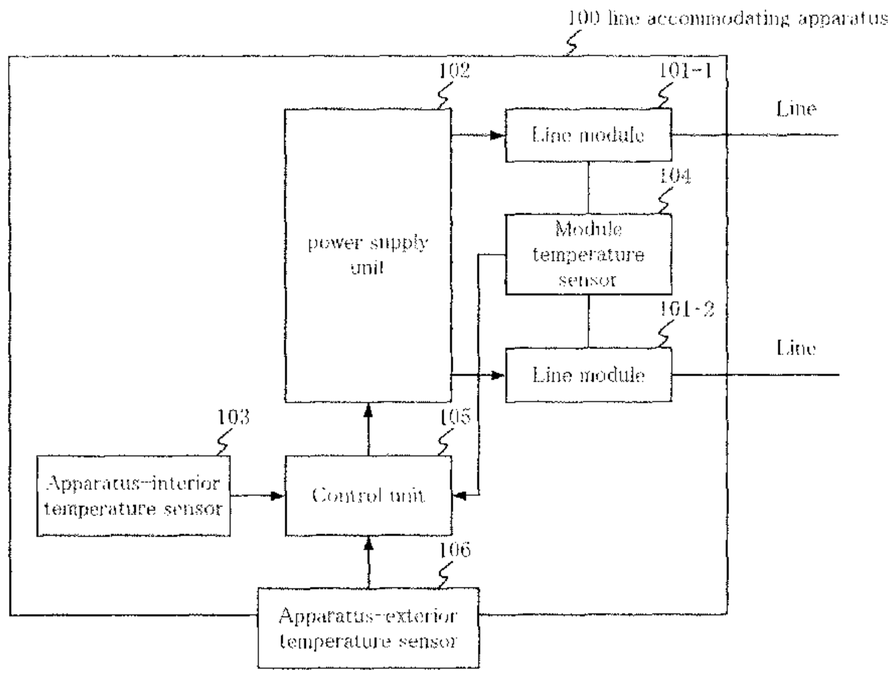
(Continued)

Primary Examiner — Rexford Barnie
Assistant Examiner — Joseph Inge
(74) *Attorney, Agent, or Firm* — McGinn IP Law Group, PLLC

(57) **ABSTRACT**

When the interior temperature inside a line accommodating apparatus (**100**) measured by an apparatus-interior temperature sensor (**103**) is equal to or higher than a predetermined first threshold value, a control unit (**105**) shuts off the supply of power from a power supply unit (**102**) to a line module (**101-1**, **101-2**) having a module temperature, measured by a module temperature sensor (**104**), higher than the sum of a predetermined second threshold value and the interior temperature.

20 Claims, 4 Drawing Sheets



(56) **References Cited**

FOREIGN PATENT DOCUMENTS

JP	2007199782 A	*	8/2007
JP	2008-256911 A		10/2008
TW	M304161 U		1/2007

OTHER PUBLICATIONS

Japanese Office Action dated Jul. 23, 2014 with a partial English translation.
Japanese Office Action dated May 9, 2014, with partial English translation.

* cited by examiner

Fig. 1

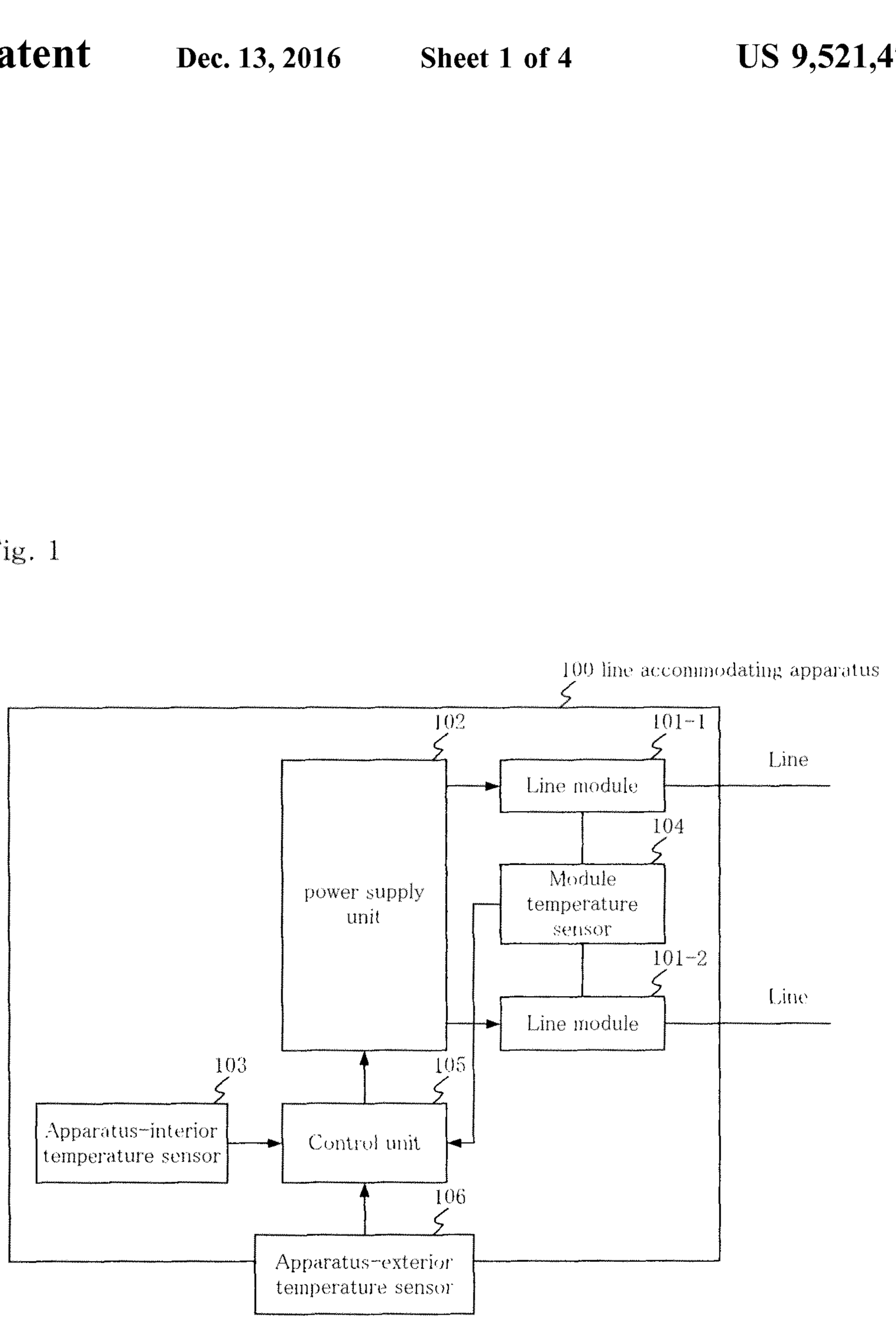

100 line accommodating apparatus
102
101-1
Line
Line module
104
power supply unit
Module temperature sensor
101-2
Line
Line module
103
105
Apparatus-interior temperature sensor
Control unit
106
Apparatus-exterior temperature sensor

Fig. 2

	threshold value
interior temperature	35 deg. C
difference between the module temperature and the interior temperature	15 deg. C
difference between the interior temperature and the exterior temperature	10 deg. C

Fig. 3

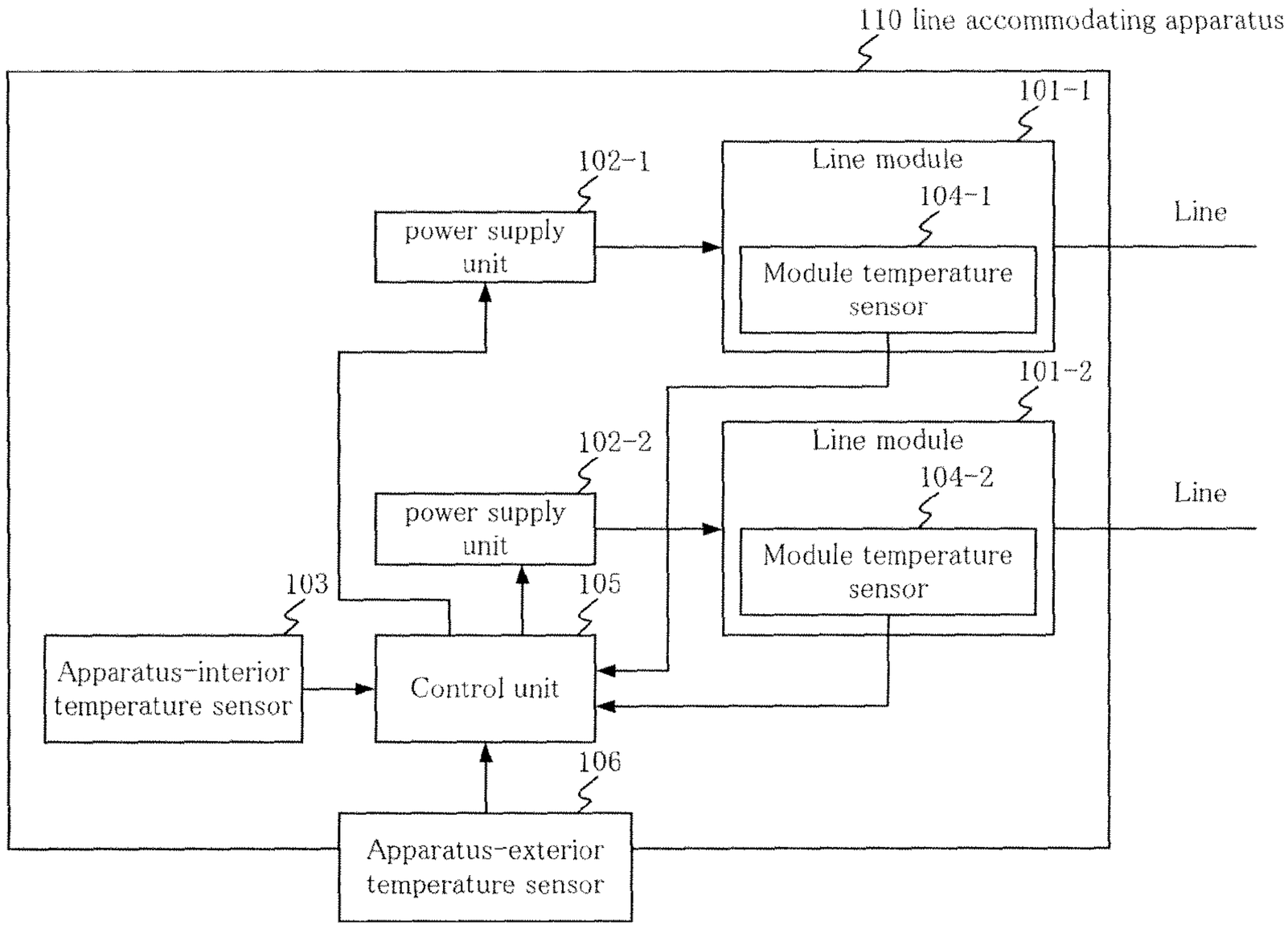
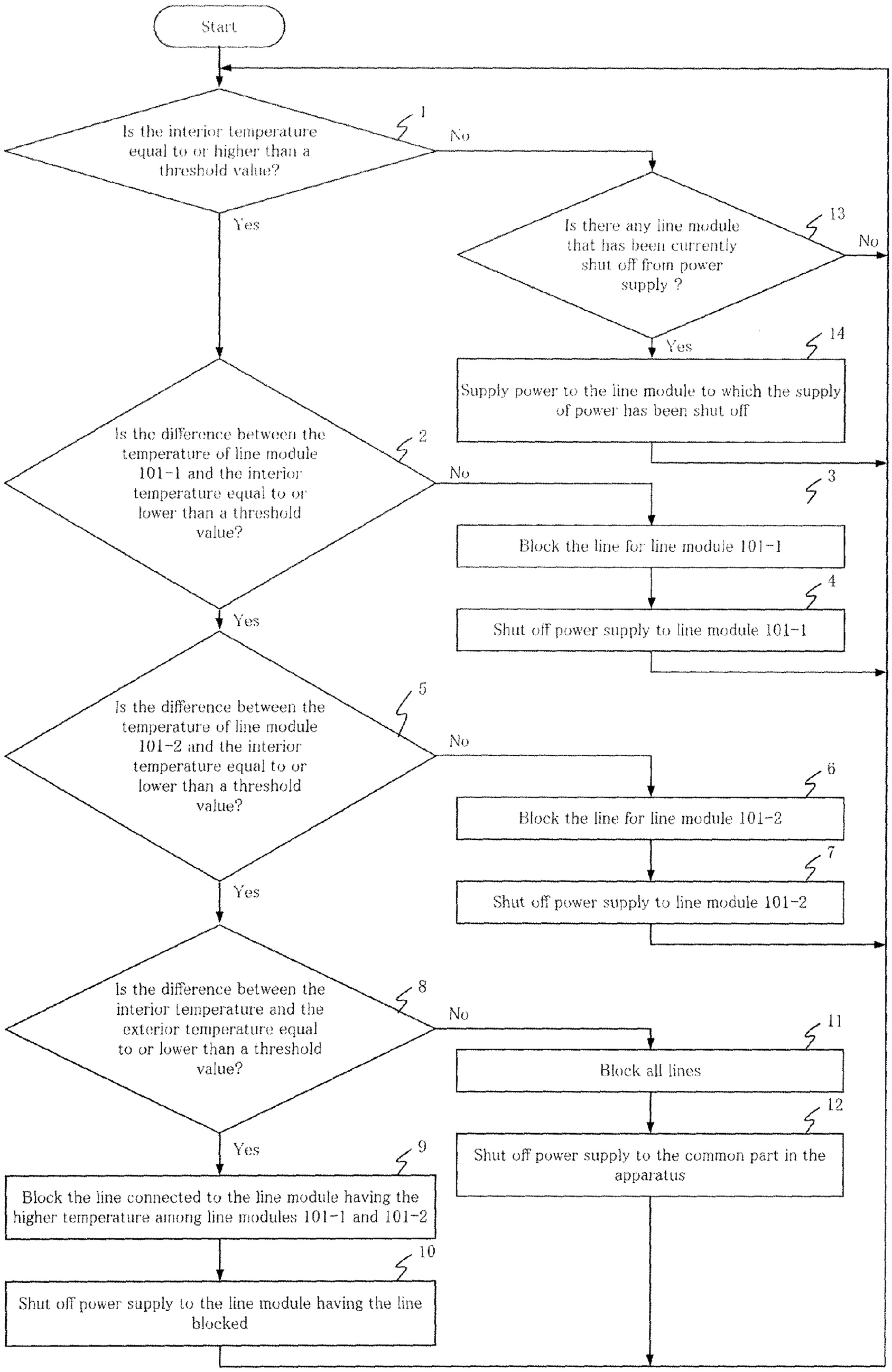

110 line accommodating apparatus
101-1
Line module
104-1
Module temperature sensor
102-1
power supply unit
Line
101-2
Line module
104-2
Module temperature sensor
102-2
power supply unit
Line
103
Apparatus-interior temperature sensor
105
Control unit
106
Apparatus-exterior temperature sensor

Fig. 4


Start
Is the interior temperature equal to or higher than a threshold value?
1
No
Yes
Is there any line module that has been currently shut off from power supply ?
13
No
Yes
14
Supply power to the line module to which the supply of power has been shut off
Is the difference between the temperature of line module 101-1 and the interior temperature equal to or lower than a threshold value?
2
No
3
Block the line for line module 101-1
4
Shut off power supply to line module 101-1
Yes
Is the difference between the temperature of line module 101-2 and the interior temperature equal to or lower than a threshold value?
5
No
6
Block the line for line module 101-2
7
Shut off power supply to line module 101-2
Yes
Is the difference between the interior temperature and the exterior temperature equal to or lower than a threshold value?
8
No
11
Block all lines
12
Shut off power supply to the common part in the apparatus
Yes
9
Block the line connected to the line module having the higher temperature among line modules 101-1 and 101-2
10
Shut off power supply to the line module having the line blocked

LINE ACCOMMODATING APPARATUS AND TEMPERATURE CONTROL METHOD

TECHNICAL FIELD

The present invention relates to a line accommodating apparatus that accommodates a plurality of lines and to a temperature control method of controlling the temperature of the interior of the line accommodating apparatus.

BACKGROUND ART

Apparatuses such as communication devices that accommodate lines are not only installed indoors but are also installed outdoors as required.

Normally, the outdoor temperature varies more widely than the indoor temperature. Accordingly, when the outdoor temperature is high, the interior temperature of an apparatus installed outdoors may increase unnecessarily due to the high level of the outdoor temperature (exterior temperature of the apparatus). In such a case, it is necessary to protect internal devices against the high temperature situation.

In general, a radiator called a "heat sink" that decreases the temperature through thermal radiation is often used to decrease the temperature of a device in operation.

There is such a technique in which the temperature inside an apparatus is monitored so as to shut off the power supply to the whole apparatus when the temperature inside the apparatus becomes higher than the normal temperature level (see Patent Document 1 for example).

PRIOR ART DOCUMENTS

Patent Document

Patent Document 1: JP2008-256911A

SUMMARY OF THE INVENTION

Problems to be Solved by the Invention

There is, however, a limit to temperature reduction using a heat sink.

In addition, the technique described in Patent Document 1 has a problem which all functions of the apparatus cease to disable the apparatus for communication and other operations when the temperature inside the apparatus becomes higher than a predetermined temperature. Also, data such as threshold values to be used by the apparatus is stored in a device connected to the apparatus via a network so that this delays the temperature control.

The object of the present invention is to provide a line accommodating apparatus and a temperature control method for solving the above-mentioned problems.

Means for Solving the Problems

A line accommodating apparatus of the present invention is a line accommodating apparatus that accommodates a plurality of lines, comprising:

a plurality of line modules connected to the plurality of lines, respectively;

a power supply unit that supplies power to each of the plurality of line modules;

an apparatus-interior temperature sensor that measures the interior temperature, which is the temperature inside the line accommodating apparatus;

a module temperature sensor that measures the module temperature, which is the temperature of each of the plurality of line modules; and

a control unit that shuts off supply of power from the power supply unit to a line module having a module temperature higher than the sum of a predetermined second threshold value and the interior temperature when the interior temperature is equal to or higher than a predetermined first threshold value.

A temperature control method of the present invention is a temperature control method of controlling the temperature inside a line accommodating apparatus including a plurality of line modules respectively connected to a plurality of lines, the method comprising the steps of:

supplying power to each of the plurality of line modules;

measuring the interior temperature, which is the temperature inside the line accommodating apparatus;

measuring the module temperature, which is the temperature of each of the plurality of line modules; and

shutting off supply of power to a line module having a module temperature higher than the sum of the predetermined second threshold value and the interior temperature when the interior temperature is equal to or higher than the predetermined first threshold value.

Effect of the Invention

As described above, according to the present invention, when the interior temperature inside the line accommodating apparatus, measured by an apparatus-interior temperature sensor, is equal to or higher than a predetermined first threshold value, the control unit shuts off supply of power from the power supply unit to a line module having a module temperature, measured by a module temperature sensor, higher than the sum of a predetermined second threshold value and the interior temperature. This feature enables devices disposed inside the apparatus to be protected against high temperature while continuing the operation of the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram showing an embodiment mode of a line accommodating apparatus of the present invention.

FIG. **2** is a diagram showing an example of threshold value data of temperature stored in the control unit shown in FIG. **1**.

FIG. **3** is a diagram showing another embodiment mode of a line accommodating apparatus of the present invention.

FIG. **4** is a flowchart for explaining a temperature control method in the line accommodating apparatus shown in FIG. **1**.

MODE FOR CARRYING OUT THE INVENTION

Embodiment modes of the present invention will be explained hereinbelow with reference to the drawings.

FIG. **1** is a diagram showing an embodiment mode of a line accommodating apparatus of the present invention.

Referring to FIG. **1**, line accommodating apparatus **100** of the present embodiment includes line modules **101-1**, **101-2**, power supply unit **102**, apparatus-interior temperature sensor **103**, module temperature sensor **104**, control unit **105**, and apparatus-exterior temperature sensor **106**.

Line modules **101-1**, **101-2** are connected respectively to plural lines accommodated in line accommodating apparatus **100**, and carry out predetermined processing for the con-

nected lines. Line modules **101-1**, **101-2** operate with power supplied from power supply unit **102**. Line module **101-1** and line module **101-2** provide mutual redundancy so as to enable line accommodating apparatus **100** to operate even when one of the line modules is down. It should be appreciated that the number of line modules may be three or more.

Power supply unit **102** supplies power to line modules **101-1**, **101-2**.

Apparatus-interior temperature sensor **103** measures the interior temperature, namely, the temperature inside line accommodating apparatus **100**.

Module temperature sensor **104** measures module temperatures, or the temperatures of line modules **101-1**, **101-2**.

Apparatus-exterior temperature sensor **106** measures the exterior temperature, or the temperature outside line accommodating apparatus **100**.

Control unit **105** controls the supply of power from power supply unit **102** to line modules **101-1**, **101-2** based on the temperatures measured by apparatus-interior temperature sensor **103**, module temperature sensor **104**, and apparatus-exterior temperature sensor **106**.

Control unit **105** stores, in advance, temperature threshold value data for controlling the supply of power from power supply unit **102** to line modules **101-1**, **101-2**.

FIG. **2** is a diagram showing an example of temperature threshold data stored in control unit **105** shown in FIG. **1**.

Control unit **105** shown in FIG. **1** stores temperature threshold value data as shown in FIG. **2**. This is preset data.

As shown in FIG. **2**, for example 35 deg. C. is stored as the threshold value for the interior temperature (first threshold value). This means that, when control unit **105** carries out a predetermined process based on the interior temperature measured by apparatus-interior temperature sensor **103**, the process is carried out with a threshold value of 35 deg. C. Also, 15 deg. C. is stored as a threshold value for the difference between the module temperature and the interior temperature (second threshold value). This means that, when control unit **105** carries out a predetermined process based on the module temperature measured by module temperature sensor **104** and the interior temperature measured by apparatus-interior temperature sensor **103**, the process is carried out with a threshold value of 15 deg. C. Further, 10 deg. C. is stored as a threshold value for the difference between the interior temperature and the exterior temperature (third threshold value). This means that, when control unit **105** carries out a predetermined process based on the interior temperature measured by apparatus-interior temperature sensor **103** and the exterior temperature measured by apparatus-exterior temperature sensor **106**, the process is carried out with a threshold value of 10 deg. C.

Details of the process carried out by control unit **105** using the threshold values shown in FIG. **2** will be described later.

Although module temperature sensor **104** measures the module temperatures of both line module **101-1** and line module **101-2** in the mode shown in FIG. **1**, individual temperature sensors may be provided for line module **101-1** and line module **101-2**, respectively.

In addition, although power supply unit **102** supplies power to both line module **101-1** and line module **101-2** in the mode shown in FIG. **1**, individual power supply units may be provided for line module **101-1** and line module **101-2**, respectively.

FIG. **3** is diagram showing another mode of a line accommodating apparatus of the present invention.

Referring to FIG. **3**, line accommodating apparatus **110** of this mode is provided with module temperature sensors **104-1**, **104-2**, respectively, in line modules **101-1**, **101-2**, in place of module temperature sensor **104** shown in FIG. **1**. Also, line accommodating apparatus **110** is provided with power supply units **102-1**, **102-2** that respectively supply power to line modules **101-1**, **101-2** that are provided in place of power supply unit **102** shown in FIG. **1**.

Now, a temperature control method of the present invention will be explained hereinafter. Specifically, the temperature control method in the mode shown in FIG. **1** is explained herein using an example.

FIG. **4** is a flowchart for illustrating a temperature control method in line accommodating apparatus **100** shown in FIG. **1**.

Initially, at Step **1** control unit **105** determines whether the interior temperature of line accommodating apparatus **100** is equal to or higher than a predetermined threshold value. Specifically, control unit **105** determines whether the interior temperature measured by apparatus-interior temperature sensor **103** is equal to or higher than the first threshold value stored in control unit **105**. Using the example of threshold value shown in FIG. **2**, whether the interior temperature measured by apparatus-interior temperature sensor **103** is equal to or higher than 35 deg. C. is determined.

When control unit **105** determines that the interior temperature measured by apparatus-interior temperature sensor **103** is equal to or higher than the first threshold value stored in control unit **105**, then it determines at Step **2** whether the difference between the module temperature of line module **101-1** and the interior temperature is equal to or lower than a predetermined threshold value. Specifically, control unit **105** determines whether the difference between the module temperature of line module **101-1** measured by module temperature sensor **104** and the interior temperature measured by apparatus-interior temperature sensor **103** is equal to or lower than the second threshold value stored in control unit **105**. In the example of threshold value shown in FIG. **2**, whether the difference between the module temperature of line module **101-1** measured by module temperature sensor **104** and the interior temperature measured by apparatus-interior temperature sensor **103** is equal to or lower than 15 deg. C. is determined. Here, the module temperature of line module **101-1** measured by module temperature sensor **104** is generally higher than the interior temperature measured by apparatus-interior temperature sensor **103**. Accordingly, this is equivalent to a determination as to whether the module temperature of line module **101-1** measured by module temperature sensor **104** is equal to or lower than the sum of the second threshold value and the interior temperature measured by apparatus-interior temperature sensor **103**.

When it is determined that the difference between the module temperature of line module **101-1** measured by module temperature sensor **104** and the interior temperature measured by apparatus-interior temperature sensor **103** is not equal to or lower than the second threshold value stored in control unit **105**, in other words, when it is determined that the module temperature of line module **101-1** measured by module temperature sensor **104** is higher than the sum of the second threshold value and the interior temperature measured by apparatus-interior temperature sensor **103**, the line connected to line module **101-1** is blocked at Step S**3** by control unit **105**. This line blocking operation may be a usual blocking operation, and it is therefore not particularly defined here.

After the line blocking operation is completed, control unit **105** shuts off the supply of power from power supply unit **102** to line module **101-1** at Step **4**.

Turning back to Step **2**, when control unit **105** determines that the difference between the module temperature of line

module **101-1** measured by module temperature sensor **104** and the interior temperature measured by apparatus-interior temperature sensor **103** is equal to or lower than the second threshold value stored in control unit **105**, in other words, when it is determined that the module temperature of line module **101-1** measured by module temperature sensor **104** is equal to or lower than the sum of the second threshold value and the interior temperature measured by apparatus-interior temperature sensor **103**, control unit **105** determines whether the difference between the module temperature of line module **101-2** and the interior temperature is equal to or lower than a predetermined threshold value at Step **5**. Specifically, control unit **105** determines whether the difference between the module temperature of line module **101-2** measured by module temperature sensor **104** and the interior temperature measured by apparatus-interior temperature sensor **103** is equal to or lower than the second threshold value stored in control unit **105**. In the example of threshold value shown in FIG. **2**, whether the difference between the module temperature of line module **101-2** measured by module temperature sensor **104** and the interior temperature measured by apparatus-interior temperature sensor **103** is equal to or lower than 15 deg. C. is determined. Generally, the module temperature of line module **101-2** measured by module temperature sensor **104** is higher than the interior temperature measured by apparatus-interior temperature sensor **103**. Accordingly, this is equivalent to a determination as to whether the module temperature of line module **101-2** measured by module temperature sensor **104** is equal to or lower than the sum of the second threshold value and the interior temperature measured by apparatus-interior temperature sensor **103**.

When it is determined that the difference between the module temperature of line module **101-2** measured by module temperature sensor **104** and the interior temperature measured by apparatus-interior temperature sensor **103** is not equal to or lower than the second threshold value stored in control unit **105**, in other words, when it is determined that the module temperature of line module **101-2** measured by module temperature sensor **104** is higher than the sum of the second threshold value and the interior temperature measured by apparatus-interior temperature sensor **103**, control unit **105** blocks the line connected to line module **101-2** at Step **6**. This line blocking operation may be a usual blocking operation, and therefore it is not particularly defined here.

After the line blocking operation is completed, control unit **105** shuts off the supply of power from power supply unit **102** to line module **101-2** at Step **7**.

Turning back to Step **5**, when it is determined that the difference between the module temperature of line module **101-2** measured by module temperature sensor **104** and the interior temperature measured by apparatus-interior temperature sensor **103** is equal to or lower than the second threshold value stored in control unit **105**, in other words, when it is determined that the module temperature of line module **101-2** measured by module temperature sensor **104** is equal to or lower than the sum of the second threshold value and the interior temperature measured by apparatus-interior temperature sensor **103**, control unit **105** determines whether the difference between the interior temperature and the exterior temperature is equal to or lower than a predetermined threshold value at Step **8**. Specifically, control unit **105** determines whether the difference between the interior temperature measured by apparatus-interior temperature sensor **103** and the exterior temperature measured by apparatus-exterior temperature sensor **106** is equal to or lower than the third threshold value stored in control unit **105**. In the example of threshold value shown in FIG. **2**, a determination is made as to whether the difference between the interior temperature measured by apparatus-interior temperature sensor **103** and the exterior temperature measured by apparatus-exterior temperature sensor **106** is equal to or lower than 10 deg. C. Generally, the interior temperature measured by apparatus-interior temperature sensor **103** is higher than the exterior temperature measured by apparatus-exterior temperature sensor **106**. Accordingly, the above determination is equivalent to a determination as to whether the interior temperature measured by apparatus-interior temperature sensor **103** is equal to or lower than the sum of the third threshold value and the exterior temperature measured by apparatus-exterior temperature sensor **106**.

When it is determined that the difference between the interior temperature measured by apparatus-interior temperature sensor **103** and the exterior temperature measured by apparatus-exterior temperature sensor **106** is equal to or lower than the third threshold value stored in control unit **105**, in other words, when it is determined that the interior temperature measured by apparatus-interior temperature sensor **103** is equal to or lower than the sum of the third threshold value and the exterior temperature measured by apparatus-exterior temperature sensor **106**, control unit **105** blocks the line that is connected to whichever module from among line module **101-1** and line module **101-2**, that has a higher module temperature, at Step **9**. In detail, control unit **105** selects one module, from among line module **101-1** and line module **101-2**, whose temperature, as measured by module temperature sensor **104**, is higher, and blocks the line connected to the selected module. This line blocking operation may be a standard blocking operation, and therefore it is not particularly defined here.

After the line blocking operation is completed, control unit **105** shuts off the supply of power from power supply unit **102** to the line module whose the line was blocked at Step **10**.

Turning back to Step **8**, when it is determined that the difference between the interior temperature measured by apparatus-interior temperature sensor **103** and the exterior temperature measured by apparatus-exterior temperature sensor **106** is not equal to or lower than the third threshold value stored in control unit **105**, in other words, when it is determined that the interior temperature measured by apparatus-interior temperature sensor **103** is not equal to or lower than the sum of the third threshold value and the exterior temperature measured by apparatus-exterior temperature sensor **106**, control unit **105** blocks the respective lines connected to line module **101-1** and line module **101-2** at Step **11**. This line blocking operation may be a usual blocking operation, and therefore it is not particularly defined here.

After the line blocking operation is completed, control unit **105** shuts off the supply of power from power supply unit **102** to common parts (not shown) in line accommodating apparatus **100** at Step **12**.

When it is determined at Step **1** that the temperature measured by apparatus-interior temperature sensor **103** is lower than the first threshold value stored in control unit **105**, control unit **105** determines whether any line module has been currently shut off from power supply at Step **13**. This determination may be carried out by storing information about the line module to which the supply of power has been shut off, when power was shut off, and retrieving the stored information.

When it is determined that the power supply to a line module has been shut down, control unit **105** controls power supply unit **102** to restart the supply of power to the line module to which the supply of power has been shut off at Step **14**. In this way, the line module to which the supply of power has been shut off is supplied with power again when the interior temperature becomes equal to or lower than a predetermined temperature.

Here, either of the process at Steps **2** to **4** or the process at Steps **5** to **7** may be carried out first. In other words, the order of determination of the module temperature of line module **101-1** and the determination of the module temperature of line module **101-2** is not defined. Further, both processes may be performed in parallel.

As described above, the power supply for a line module determined to have an unnecessarily high temperature is shut off to thereby suppress heat generation due to operation of the line module, hence making it possible to reduce the interior temperature in line accommodating apparatus **100**. This enables internal devices to be protected against any damage and failure due to high temperature. Further, the supply of power is shut off for each line module so that it is not necessary to terminate the operation of line accommodating apparatus **100**. Consequently, improvement in service is expected since the operation can be maintained even when the exterior temperature becomes higher than expected, and also a cost benefit can be anticipated since it will not be necessary to use a device that is preset to supporting a special temperature range.

It should be understood that the present invention is not limited to the above-described configuration, and the present invention can be applied to any other apparatus in addition to the communication devices used in a communication system as long as the device has a plurality of operation lines and as long as the power supply to the operation lines can be individually shut down.

Although the present invention has been explained with reference to the embodiment mode as above, the present invention should not be limited to the embodiment mode. Various modifications that can be understood by those skilled in the art may be made to the form and details of the present invention within the scope of the present invention.

This application claims priority based on Japanese Patent Application No. 2009-179341, filed on Jul. 31, 2009, and should incorporate all the disclosure thereof herein.

The invention claimed is:

1. A line accommodating apparatus that accommodates a plurality of lines, the line accommodating apparatus comprising:

a plurality of line modules connected to the plurality of lines, respectively;

a power supply unit that supplies power to each of the plurality of line modules;

an apparatus-interior temperature sensor that measures an interior temperature, which is a temperature inside the line accommodating apparatus;

a module temperature sensor that measures a module temperature, which is a temperature of each of the plurality of line modules;

an apparatus-exterior temperature sensor that measures an exterior temperature, which is a temperature outside the line accommodating apparatus; and

a control unit that shuts off a supply of power from the power supply unit to a line module of the plurality of line modules having a module temperature higher than a sum of a predetermined non-zero second threshold value and the interior temperature when the interior temperature is equal to or higher than a predetermined first threshold value, the predetermined first threshold value and the predetermined non-zero second threshold value being determined by a specific method,

wherein said control unit shuts off a supply of power from the power supply unit to a line module having a highest module temperature when a difference between the interior temperature and the exterior temperature is greater than a predetermined third threshold value which is stored in the control unit.

2. The line accommodating apparatus according to claim **1**,

wherein the control unit shuts off the supply of power from the power supply unit to the line module having the highest module temperature when the interior temperature is equal to or higher than the predetermined first threshold value, when no line module having a module temperature that is higher than the sum of the second threshold value and the interior temperature exists, and when the interior temperature is equal to or lower than a sum of the predetermined third threshold value and the exterior temperature.

3. The line accommodating apparatus according to claim **1**, wherein the control unit supplies power from the power supply unit to a line module of the plurality of line modules to which the supply of power has been shut off when the interior temperature is lower than the first threshold value.

4. The line accommodating apparatus according to claim **1**, wherein the control unit, upon shutting off the supply of power from the power supply unit to the line module, blocks a line having the line module connected thereto and then shuts off the supply of power.

5. The line accommodating apparatus according to claim **1**, wherein the plurality of line modules are mutually redundant.

6. The line accommodating apparatus according to claim **2**, wherein the control unit, upon shutting off the supply of power from the power supply unit to the line module, blocks a line having the line module connected thereto and then shuts off the supply of power.

7. The line accommodating apparatus according to claim **2**, wherein the plurality of line modules are mutually redundant.

8. The line accommodating apparatus according to claim **1**, wherein the control unit detects the line module as an unusual line module based on the interior temperature measured by the apparatus-interior temperature sensor and the module temperature measured by the module temperature sensor.

9. The line accommodating apparatus according to claim **1**, wherein the control unit is configured to restart the supply of power from the power supply unit to the line module to which the supply power is shut off when the interior temperature becomes lower than the predetermined first threshold value.

10. The line accommodating apparatus according to claim **1**, wherein the control unit is configured to shut off the supply of power from the power supply unit to each of the line modules individually.

11. The line accommodating apparatus according to claim **1**, wherein the predetermined first threshold value includes a value that corresponds to the interior temperature and is measured in advance when all of the plurality of line modules operate in a normal state.

12. The line accommodating apparatus according to claim **11**, wherein the predetermined non-zero second threshold value includes a difference in value between the module

temperature that the module temperature sensor measures when the line module of the plurality of line modules is not operating in the normal state and the module temperature that the module temperature sensor measures in advance when the line module of the plurality of line modules is operating in the normal state.

13. A temperature control method of controlling the temperature inside a line accommodating apparatus including a plurality of line modules respectively connected to a plurality of lines, the method comprising:

supplying power to each of the plurality of line modules;

measuring an interior temperature, which is a temperature inside the line accommodating apparatus;

measuring a module temperature, which is a temperature of each of the plurality of line modules;

measuring an exterior temperature, which is a temperature outside the line accommodating apparatus; and

shutting off a supply of power to a line module of the plurality of line modules having a module temperature higher than a sum of a predetermined non-zero second threshold value and the interior temperature when the interior temperature is equal to or higher than a predetermined first threshold value, the predetermined first threshold value and the predetermined non-zero second threshold value being determined by a specific method, and shutting off the supply of power to a line module of the plurality of line modules having a highest module temperature when a difference between the interior temperature and the exterior temperature is greater than a predetermined third threshold value which is stored in a control unit.

14. The temperature control method according to claim **13**, further comprising:

shutting off a supply of power to the line module having the highest module temperature when the interior temperature is equal to or higher than the predetermined first threshold value, when no line module having a module temperature that is higher than the sum of the second threshold value and the interior temperature exists, and when the interior temperature is equal to or lower than a sum of the predetermined third threshold value and the exterior temperature, the predetermined third threshold value being determined by the specific method.

15. The temperature control method according to claim **13**, further comprising:

supplying power to a line module of the plurality of line modules to which the supply of power has been shut off, when the interior temperature is lower than the first threshold value.

16. The temperature control method according to claim **13**, further comprising:

upon shutting off the supply of power to the line module, shutting off the supply of power to the line module after a line connected to the line module has been blocked.

17. The temperature control method according to claim **14**, further comprising:

upon shutting off the supply of power to the line module, shutting off the supply of power to the line module after a line connected to the line module has been blocked.

18. The temperature control method according to claim **13**, wherein the shutting off of the supply of power comprises detecting the line module as an unusual line module based on the measured interior temperature and the measured module temperature.

19. The temperature control method according to claim **13**, further comprising:

restarting the supply of power from the power supply unit to the line module to which the supply power is shut off when the interior temperature becomes lower than the predetermined first threshold value.

20. The temperature control method according to claim **13**, wherein the shutting off supply of power comprises shutting off the supply of power from the power supply unit to each of the line modules individually.

* * * * *